

therefrom. As **FIG. 5** illustrates, to utilize the invention as a fastener extractor, the fastener to be extracted is placed within collet bottom end **204**. **FIG. 6** is a top perspective view of a fastener extraction tool according to a preferred embodiment of the present invention. As Jam wheel **206** is rotated, collet bottom end **204** withdraws into jam tube bottom end **301**, thereby constricting collet bottom end **204** around the fastener to be extracted. Once collet bottom end **204** has positively engaged the fastener, hand wheel **202** can be rotated, thereby causing the fastener to be extracted. **FIG. 7** is a perspective view of a screw being removed by a fastener extraction tool according to a preferred embodiment of the present invention.

[0036] In the event the fastener cannot be extracted by hand, drill stop **210**, and corresponding drill bit **208**, can be used to facilitate fastener extraction. Drill bit **208** can be inserted into collet **203**, and can make contact with the fastener. Drill stop **210** can preferably be configured to prevent drill bit **208** from extending beyond a desired depth, thereby preventing drill bit **208** from damaging any surrounding material. **FIG. 8** is a profile view of a screw which has been removed using a fastener extraction tool according to a preferred embodiment of the present invention. Because drill bit **208** is contained within collet **203**, and collet **203** is effectively sealed around the screw, all FOD generated during the drilling process is preferably collected within collet **203**.

[0037] **FIG. 9** provides a flow chart of a preferred method for using the present invention. As **FIG. 9** illustrates, the method preferably includes setting the drill stop to limit its travel to approximately the depth of the screw head (Block **900**) and seating the tool over the fastener to be extracted (Block **905**). The collet is tightened onto the head or other protruding portion of the fastener using the jam wheel (Block **910**). With the collet securely in place around the fastener, the outer wheel is turned in an effort to remove the fastener (Block **915**). If the fastener can be extracted (Block **920**), it is removed and the entire tool, including the extracted fastener, is preferably taken out of the clean room or to a proper FOD disposal site before the fastener is removed from the tool (Block **940**) and any FOD is removed from the tool (Block **945**). If the fastener turns in place (Block **920**), this indicates that the material into which the fastener has been inserted, such as, but not limited to, a nut or nut plate, has broken free. A drill stop and corresponding drill are then preferably applied using slight pressure and a slow bit rotation rate (Block **930**). Additional pressure can be added once the drill bit has worked its way through the damaged or remaining portion of the fastener (Block **935**). Once the fastener can be extracted (Block **920**), it is removed and the entire tool, including the extracted fastener, is preferably taken out of the clean room or to a proper FOD disposal site before the fastener is removed from the tool (Block **940**) and any FOD is removed from the tool (Block **945**).

[0038] While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to those skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[0039] I claim as my invention:

1. A method of removing a fastener using a fastener extraction tool, comprising:
 - attaching a jam tube to a hand wheel;
 - inserting a collet into the jam tube;
 - attaching a jam wheel to a first end of the collet to form a fastener extraction tool;
 - seating the fastener extraction tool onto an exposed surface of the fastener, wherein the exposed fastener surface fits within a second end of the collet;
 - tightening the fastener extraction tool onto the exposed fastener surface;
 - attempting to rotate the fastener extraction tool to remove the fastener; and
 - removing the fastener if the attempt is successful.
2. The method of claim 1, wherein the collet and jam wheel are attached by way of threads.
3. The method of claim 2, wherein rotation of the jam wheel causes the collet to engage the jam tube.
4. The method of claim 1, wherein the tightening step involves mechanically operating the jam wheel such that the collet engages the jam tube.
5. The method of claim 4, wherein mechanically operating the jam wheel causes at least a portion of the collet to contract.
6. The method of claim 1, further comprising, if the fastener removal attempt is unsuccessful, further performing:
 - setting a drill stop depth associated with the fastener extraction tool to be less than or equal to the length of the fastener;
 - attaching a drill motor to the fastener extraction tool;
 - removing at least a portion of the fastener using a drill bit;
 - turning the drill bit until the drill bit becomes coupled with the fastener or the drill stop depth is reached; and
 - removing the fastener.
7. The method of claim 6, wherein the drill bit comprises a left-hand threaded bit.
8. The method of claim 1, further comprising taking the tool to a clean area to remove foreign object debris from the tool.
9. The method of claim 1, wherein the collet is chosen such that the head of an MD112-1003-xxx type screw fits within the collet.
10. The method of claim 9, wherein the outer diameter of the jam tube fits in a $\frac{3}{8}$ " diameter hole.
11. An apparatus for removing a damaged fastener, comprising:
 - a hand wheel;
 - a jam tube, operably coupled to the hand wheel;
 - a collet, wherein at least a portion of the collet fits within at least a portion of the jam tube, the collet being formed to create a tube;